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Two *Oudemansiella* species with echinulate basidiospores from South America with *O. macracantha* lectotypified

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Abstract—A recent collection of *Oudemansiella steffenii* from the State of Pernambuco, Brazil, is described and compared to the type of *O. macracantha,* which is lectotypified here. Photographs of both basidiomes and microstructures are also provided.

Key words— *Agaricales*, Neotropics, *Physalacriaceae*, taxonomy

Introduction

Recent molecular and phylogenetic studies showed that species covered by dense long hairs, such as *Xerula hispida* Halling & G.M. Muell. (1999) and *X. setulosa* (Murrill) R.H. Petersen & T.J. Baroni (2007), form a well supported clade while non-hispid species of *Xerula* Maire and *Oudemansiella* Speg. s. str. taxa form another (Mueller et al. 2001). The bootstrap value between these clades is low and the hairy *Xerula* and all other *Oudemansiella* sensu Singer (1986) represent two distinct genera also supported by recent morphological studies (Wang et al. 2008, Yang et al. 2009).

Among the sections proposed in the rearrangement of *Oudemansiella* by Yang et al. (2009), the species with echinulate basidiospores, *O. steffenii* and *O. macracantha*, initially placed at the subgenus level by Clémençon (1979), belong to sect. *Dactylosporina* (Clémençon) Pegler & T.W.K Young, as already reported by Pegler & Young (1986).

In this study, recent collections of *O. steffenii* and the type of *O. macracantha* were studied in order to clarify the species concepts among the taxa of sect. *Dactylosporina*.

Materials and methods

Microscopic observations were made from material mounted in 3% KOH and Congo Red solutions. Presentation of basidiospore data follows the methodology proposed by Tulloss et al. (1992), but utilizing a single basidioma (Wartchow 2009). The notation "[*a*/*b*/*c*]" at the beginning of the spore data set is to be read "*a* spores measured from *b* basidiomes taken from *c* collections." Other abbreviations include **L(W)** = basidiospore length (width) average from a single basidiome, Q = the length : width ratio range as determined from all measured basidiospores, and **Q** = the Q value averaged from all basidiospores measured within a single basidiome. Color codes used in the description of the species are those from Watling (1969). Herbaria codes and names follow Holmgren & Holmgren (2001). Description of dried material of *O. macracantha* follows the style of the type studies of Yang (2000).

Taxonomy

Oudemansiella steffenii (Rick) Singer, Lilloa 26: 66. 1953. Figs. 1–7

Material examined: BRAZIL. **Pernambuco**, Recife, Campus UFPE, 01.vi.2007, *J. Pereira s.n.* (URM 79226).

Basidiome medium-sized. Pileus to 65 mm in diam., plano-umbonate to concave-umbonate, brown ('milk coffee' 26) to slightly paler ('snuff brown' 17) at margin, narrowly sulcate-striate (5–10 mm) when fresh, more indistinct in dried state; context thin, fleshy. Lamellae adnexed to somewhat sub-free, white to cream, somewhat brown at edges, 4–8 mm wide, subdistant; lamellulae very common, 14–20 mm long, frequently truncate. Stipe 95 × 4–8 mm, cylindrical above bulb to tapering near apex, brown ('clay buff' 32 to 'snuff brown' 17); bulb inflating to 6–12 mm, pseudorrhiza very long, 25–100 mm; context pale cream, solid.

Basidiospores [25/1/1] 12–15.5 × 11–14.5 µm (without ornamentation), **L** = 13.2 µm, **W** = 12.7 µm, Q = 1.00–1.11(–1.16), **Q** = 1.04, globose only infrequently subglobose, moderately thick walled, strongly spinose with > 30 spines (2–)3.5–5(–5.5) µm long, subacute to subobtuse, infrequently with acute tips, inamyloid, colorless, with guttulate contents. Basidia 50–60 × 13–15 µm, clavate, 4-sterigmate, sterigmata to 9 × 4.5 µm (width measured at base). Pleurocystidia scattered 60–120 × 18–36 µm, fusoid to lageniform, rounded-obtuse to subcapitate, infrequently subacute, thick-walled (1.5–3 µm), hyaline, colorless. Cheilocystidia not observed. Pileipellis a hymenoderm layer consisting of elements 22–45 × 14.5–22 µm, somewhat to broadly clavate or more or less pyriform (e.g. 30 × 11 µm or 70 × 22 µm), all rounded-obtuse at

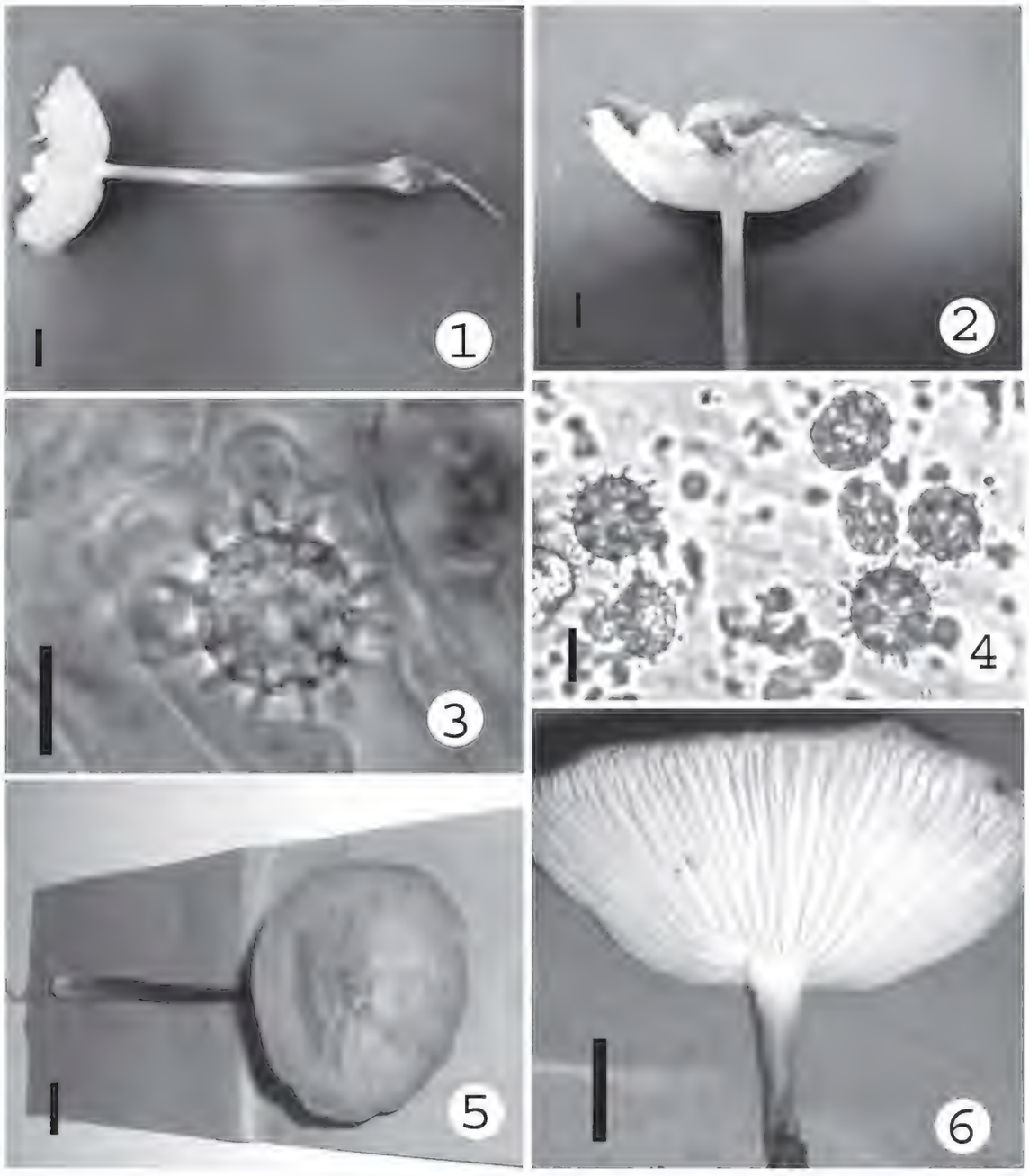

Fig. 1–6. *Oudemansiella steffenii*. 1–2. Basidiome (URM 79226). 3–4. Basidiospores (URM 79226). 5–6. Basidiome (URM 79227). Scale bar is 10 mm for basidiomes and 10 µm for microstructures. (Photos: 1–4 by J. Pereira; 5–6 by A.C. Gomes-Silva).

apex, brownish or slightly paler pigmented, walls to 1 µm thick, arising from a hypoderm of filamentous hyphae 4–8 µm wide. Lamella trama regular to somewhat sub-irregular, with filamentous hyphae frequently septate, 3–6 µm wide, somewhat inflated to 13–18 µm, occasionally clamped.

Habitat: Solitary or scattered, on soil (attached to buried rotting wood?) in urban area.

Additional specimens examined: BRAZIL, **Pernambuco**, Recife, 'Reserva Ecológia Dois Irmãos', 03.vii.2006, *F. Wartchow 10/2006* (URM 80090); São Vicente Férrer, 'Mata do Estado', 26.vi.2008, *V.R.M. Coimbra & F. Wartchow s.n.* (URM 80091); **Rio Grande do Sul**, Santa Maria, Camobi, 'Morro do Elefante', 20.i.2001, *F. Wartchow 05/01* (SMDB 9189); Vera Cruz, Travessa Dona Josefa, 26.v.1987, *J. Putzke s.n.* (HCB 12143); **Rondônia**, Porto Velho, PVH, 22.i.2008, *A.C. Gomes-Silva 348* (URM 79227).

Distribution: Argentina, Bolivia, Costa Rica, Colombia, Mexico, Panamá, and Venezuela [Singer 1964, Halling & Mueller 1999 as *Xerula steffenii* (Rick) Boekhout & Bas, probably Petersen 2008 as *Xerula macracantha* (Singer) Boekhout & Bas]. Brazil: Amazonas, Minas Gerais, Paraná, Pernambuco, Rio Grande do Sul, São Paulo [Singer 1964, Putzke & Pereira 1988, Souza & Aguiar 2004, Capelari & Gugliotta 2005 as *Dactylosporina steffenii* (Rick) Dörfelt, Sobestiansky 2005, de Meijer 2006 as *Xerula steffenii*, Drechsler-Santos et al. 2007, Rosa & Capelari 2009 as *Dactylosporina steffenii*]. *Oudemansiella steffenii* is a new record from the State of Rondônia, North Brazil.

Remarks: Our description of *O. steffenii* is based on material recently collected in Pernambuco. It differs from *O. macracantha* in the following: (1) the larger basidiomata, (2) a more robust stipe, and (3) more numerous spines in the basidiospores. On the other hand, our material of *O. steffenii* shares with *O. macracantha* the pileus color and relatively long spines in some of the basidiospores. For a better understanding of species concepts among the echinulate spored species of *Oudemansiella*, the type of *O. macracantha* from Bolivian Amazon region was analyzed.

Other materials of *O. steffenii* analyzed (HCB 12143, SMDB 9189, URM 79227) show some differences in comparison with the Pernambuco collection. The majority of basidiospores of these materials have spines that are only rarely longer than 3 µm, except for URM 80091, in which at least one basidiospore showed spines up to 5 µm long. Previous descriptions (Singer 1964, Putzke & Pereira 1988, Halling & Mueller 1999, Capelari & Gugliotta 2005) also describe shorter basidiospore spines for *O. steffenii* compared to *O. macracantha*.

In URM 79226 (described above) thicker walled cystidia were also observed compared to those observed by the authors cited above; wall thickness, however, is not taxonomically diagnostic, since other collections (e.g., URM 80091) also had thick-walled cystidia.

In URM 79226 and SMDB 9189, an entirely brown pileus was observed, and in URM 79227 (recently collected in Amazon Forest, state of Rondônia), grayish tints were present in the sulcate margin, and spines mostly 2–3 µm long (occasionally ranging to 3.5 µm long) were observed. The pileus color pattern and spine length are also obvious features of *O. steffenii*.

Oudemansiella macracantha Singer, Sydowia 15: 59. 1962 ('1961'). Figs. 8–12

Material examined: BOLIVIA, **Vaca Diez**, Depto. Beni, Guayaramerín, 16.iii.1956, *R. Singer B 1997* (BAFC 51670 **lectotypus hic designatus**); same place, 17.iii.1956, *R. Singer B 2112* (LIL).

Pileus 6–8 mm in diam., plane, surface brown ('snuff brown 17') to vinaceous brown ('umber 18'), somewhat paler at center ('milk coffee 28'), margin entire. Lamellae adnate, subclose to subdistant, buff ('buff 52'), edge slightly darker; lamellulae rare or absent. Stipe to 80 × 0.5 mm (fragmented), cylindric but slightly tapering upward.

Basidiospores [40/2/2] (10–)11–15(–16) × (9.5–)10.5–14(–15) µm (without ornamentation), **L** = 13.4 µm, **W** = 12.8 µm, Q = 1.00–1.07(–1.17), **Q** = 1.04, globose, only infrequently subglobose or broadly ellipsoid, moderately thick walled, strongly spinose having about 23 spines mostly 4.5–5.5 µm, only occasionally 2–2.5 µm long and only occasionally to 7 µm long (in R. Singer B 2112), tips subacute, inamyloid, colorless, with guttulate contents. Basidia 67 × 22 µm, clavate, 4-sterigmate, up to 9 × 4.5 µm (width measured at base). Pleurocystidia difficult to locate (probably due to age of material), 60–72 × 27 µm, fusoid, rounded-obtuse, wall slightly thickened, hyaline, colorless. Cheilocystidia not observed. Pileipellis a hymenoderm consisting of elements 22 × 17 µm, broadly clavate, occasionally narrowly clavate or more or less pyriform, all rounded-obtuse at apex, brownish pigmented. Stipitipellis covered by caulocystidia 27–95(–180) × 14.5–22.5(–27), common, fusoid-lageniform, brownish pigmented that is somewhat condensed. Lamella trama regular or appearing somewhat subregular, with filamentous hyphae frequently septate, 2.5–5.5 µm wide, occasionally clamped.

Habitat: On buried wood in tropical rain forests, rather common, but scattered, fruiting in rainy seasons (Singer 1964).

Distribution: This species is restricted to the frontier Amazon region between Brazil and Bolivia.

Remarks: *Oudemansiella macracantha* previously was known only from the Bolivian Amazon region (Singer 1964), although recently it was reported from Argentina and Mexico by Petersen (2008 as *Xerula macracantha*), who reported an additional feature that could segregate the echinulate spored *Oudemansiella*: in *O. macracantha*, the spines remain turgid in spite of the vacuum applied by electron microscope, while in *O. steffenii* they are partially collapsed after SEM preparation. This observation was entirely based on recently collected material and not the type. Petersen (2008) also reported that the number and length of basidiospore spines in *O. macracantha* were more numerous and longer than those of *O. steffenii*. This conclusion, however, does not match satisfactorily with Singer (1964) who cited 38–42 spines per basidiospore in *O. steffenii* and only 23 in *O. macracantha*. Fewer spines were also observed on the type. The images provided by Petersen (2008) probably correspond to *O. steffenii* due the relatively shorter basidiospore spines depicted compared to the type specimen.

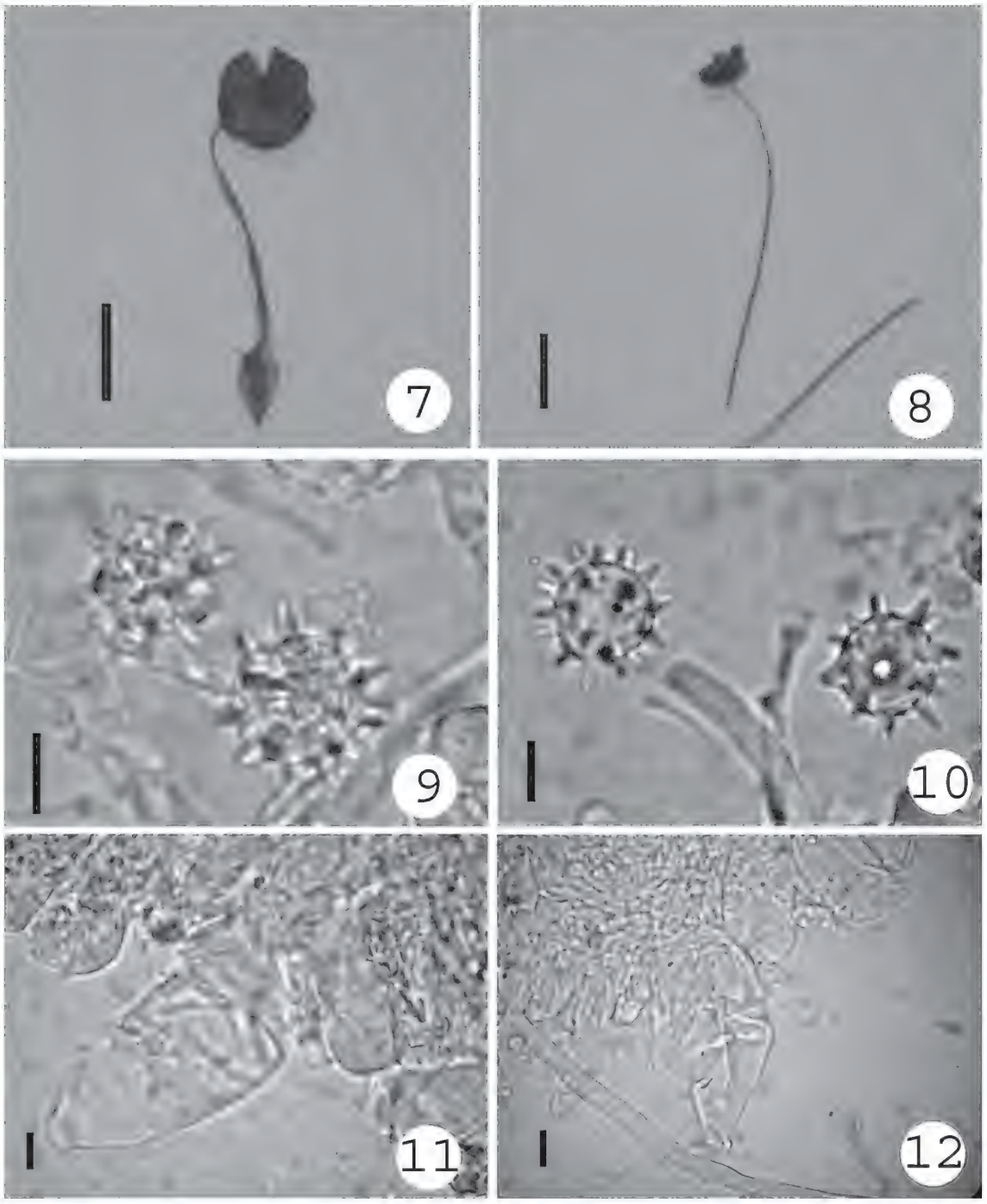

Fig. 7. *Oudemansiella steffenii*. Dry basidioma (HCB 12143).
Fig. 8–12. *Oudemansiella macracantha*.
8. Lectotype. 9–10. Basidiospores. 11–12. Pleurocystidia.
Scale bar is 10 mm for basidiomes and 10 µm for microstructures.
(Photos: 7–12 by F. Wartchow).

The material from the State of São Paulo referred to as *O. macracantha* by Pegler (1997) is thought to represent *O. steffenii* by Capelari & Gugliotta (2005), although they did not study the type; the material from Paraná is missing (de Meijer 2006).

Summarizing, *O. macracantha* is a well defined species that Singer (1964) differentiated by the small pileus (< 15 mm in diam.), longer and much more slender stipe, and basidiospores with longer, less numerous spines.

Oudemansiella macracantha appears, in fact, restricted to its type locality. Some collections of *O. steffenii* (e.g., HCB 12143, URM 80090) also present a relatively slender basidiome like the type material of *O. macracantha*, but they have the proportionally shorter stipe and obviously shorter spines that are more commonly to *O. steffenii*.

We also address in this paper the issue of the type collection for *O. macracantha*. In the protologue, Singer (1962) implied Singer B 2525 as holotype, not citing any other material. Later, Singer (1964) indicated that the collection under this number had a putative isotype at BAFC. However, the B 2525 holotype cannot be located at LIL (A. Hladki pers. corr.), and the B 2525 isotype collection cannot be located at BACF (S. Pereira, pers. corr.). On the other hand, Singer B 1997 and Singer B 2112 are the only specimens deposited in BAFC and LIL, respectively. They were collected in 1956 and identified by Singer himself, and, although no determination date is noted on the herbarium sheet label, we believe that they represent part of the original material of the species (McNeill et al. 2006: Art. 9.10).

The authors also asked whether any material labeled as *Oudemansiella macracantha* is available at F, FH, or MICH, institutions where Rolf Singer also worked and deposited materials (Mueller 1995, Mueller & Wu 1997). All responded that no materials exist under this name. The exsiccata of INPA are available at Species Link System < www.splink.org.br/index> and no exsiccatum named *O. macracantha* is available in this herbarium. Thus, the authors choose here to designate Singer B 1997 (BAFC 51670) as the lectotype of *O. macracantha*.

Oudemansiella glutinosa Singer from Colombia, which also has ornamented basidiospores, differs from *O. macracantha* and *O. steffenii* in the gelatinized zones in pileus and stipe and the considerably smaller basidiospores (14–16.5 × 12–14 µm, including the 2–3 mm high ornamentation; Singer 1989). The basidiospores of *O. macracantha* and *O. steffenii* range more than 20 mm with ornamentations (Singer 1964).

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References

Capelari M, Gugliotta AM. 2005. *Dactylosporina* e *Oudemansiella* (*Tricholomataceae*, *Oudemansiellinae*) do Parque Estadual das Fontes do Ipiranga (PEFI), São Paulo, SP. Hoehnea 32: 381–387.

Clémençon H. 1979. Taxonomic structure of the genus *Oudemansiella* (*Agaricales*). Sydowia 32: 74–80.

Drechsler-Santos ER, Pastorini LH, Putzke J. 2007. Primeiro relato de fungos *Agaricales* em fragmento de mata nativa em Frederico Westphalen – RS. Rev. Bras. Biociências 5: 471–473.

Halling RE, Mueller GM. 1999. A new species and a new record for the genus *Xerula* (*Agaricales*) from Costa Rica. Mycotaxon 71: 105–110.

Holmgren PK, Holmgren NH. 2001. Index Herbariorum on the Internet. <http://www.nybg.org/bsci/ih/ih.html>. accessed 23 September 2009.

McNeill J, Barrie FR, Burdet HM, Demoulin V, Hawksworth DL, Marhold K, Nicolson DH, Prado J, Silva PC, Skog JE, Wiersema JH, Turland NJ (Eds.). 2006. International Code of Botanical Nomenclature (Vienna Code). Regnum Vegetabile 146. A.R.G. Gantner Verlag KG.

de Meijer AAR. 2006. Preliminary list of the macromycetes from the Brazilian State of Paraná. Bol. Mus. Bot. Municipal (Curitiba) 68: 1–55.

Mueller GM. 1995. Rolf Singer, 1906–1994. Mycologia 87: 144–147.

Mueller GM, Wu Q-X. 1997. Mycological contribution of Rolf Singer: field itinerary, index to new taxa, and list of publications. Fieldiana Bot. 8: 1–124

Mueller GM, Wu Q-X, Huang Y-Q, Guo S-Y, Aldana-Gomez R, Vilgalys R. 2001. Assessing biogeographic relationships between North American and Chinese macrofungi. J. Biogeogr. 28: 271–281. doi:10.1046/j.1365-2699.2001.00540.x

Pegler DN. 1997. The agarics of São Paulo, Brazil. Royal Botanic Garden, Kew.

Pegler DN, Young TWK. 1986. Classification of *Oudemansiella* (*Basidiomycota*, *Tricholomataceae*) with special reference to spore structure. Trans. Br. Mycol. Soc. 87: 583–602. doi:10.1016/S0007-1536(86)80099-7

Petersen RH. 2008. Scanning electron microscope images of basidiospores of *Xerula* (*Physalacriaceae*, *Agaricales*). Mycoscience 49: 19–34. doi:10.1007/s10267-007-0387-z

Petersen RH, Baroni TJ. 2007. *Xerula hispida* and *Xerula setulosa* (comb. nov.), two similar subtropical New World agarics. Mycotaxon 101: 113–136.

Putzke J, Pereira AB. 1988. O gênero *Oudemansiella* Speg. no Rio Grande do Sul, Brasil. Cad. Pesq. Ser. Bot. 1: 47–69.

Rosa LH, Capelari M. 2009. *Agaricales* fungi from Atlantic Rain Forest fragments in Minas Gerais, Brazil. Braz. J. Microbiol. 40: 846–851. doi:10.1590/S1517-83822009000400015

Singer R. 1962 ('1961'). Diagnosis fungorum novorum Agaricalium. II. Sydowia 15: 45–83.

Singer R. 1964. *Oudemansiellinae*, *Macrocystidiinae*, *Pseudohiatulinae* in South America. Monographs of South American Basidiomycetes especially those of the east slope of the Andes and Brazil. VIII. Darwiniana 13: 145–190.

Singer R. 1986. The *Agaricales* in modern taxonomy. 4th ed. Koeltz Scientific Books, Koenigstein.

Singer R. 1989. New taxa and new combinations of *Agaricales* (Diagnoses Novorum Agaricalium IV). Fieldiana Bot. 21: 1–133.

Sobestiansky G. 2005. Contribution to a macromycete survey of the states of Rio Grande do Sul and Santa Catarina in Brazil. Braz. Arch. Biol. Technol. 48: 437–457. doi:10.1590/S1516-89132005000300015

Souza HQ, Aguiar IJA. 2004. Diversidade de *Agaricales* (*Basidiomycota*) na reserva biológica Walter Egler, Amazonas, Brasil. Acta Amazonica 34: 43–51. doi:10.1590/S0044-59672004000100006

Tulloss RE, Ovrebo CL, Halling RE. 1992. Studies on *Amanita* (*Amanitaceae*) from Andean Colombia. Mem. New York Bot. Gard. 66: 1–46.

Wang L, Yang Z-L, Zhang L-F, Mueller GM. 2008. Synopsis and systematic reconsideration of *Xerula* s. str. (*Agaricales*). Acta Bot. Yunnanica 30: 631–644.

Wartchow F. 2009. *Volvariella cubensis*: a rare neotropical agaric new to South America. Mycotaxon 107: 181–187.

Watling R. 1969. Color Identification Chart. Her Majesty's Stationery Office, Edinburgh.

Yang Z-L. 2000. Revision of the Chinese *Amanita* collections deposited in BPI and CUP. Mycotaxon 75: 117–130.

Yang Z-L, Zhang L-F, Mueller GM, Kost GW, Rexer K-H. 2009. A new systematic arrangement of the genus *Oudemansiella* s. str. (*Physalacriaceae*, *Agaricales*). Mycosystema 15: 1–13.